

CLAIM AMENDMENTS

1. (Currently Amended) A semiconductor optical device comprising:
a waveguide layer including two cladding layers and an active layer sandwiched
between the two cladding layers; and
a reflecting multi-layer film ~~formed including a plurality of layers and disposed~~ on at
least one of a pair of opposing end faces of the waveguide layer, wherein
a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive ~~index indexes~~ n_i and ~~film~~
~~thickness thicknesses~~ d_i ~~for each of a layer denoted with i in~~ i layers of the reflecting multi-
layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a
~~relationship:~~

$$\Sigma n_i d_i > \lambda_0/4, \text{ and}$$

~~wherein~~ a first wavelength bandwidth $\Delta\lambda$ is wider than a second wavelength
bandwidth $\Delta\Lambda$, the first wavelength bandwidth $\Delta\lambda$ being a wavelength range including the
wavelength λ_0 in which a reflectance R of the reflecting multi-layer film is not higher than
+2.0% ~~from~~ of reflectance R at the wavelength λ_0 , the second wavelength bandwidth $\Delta\Lambda$
being a wavelength range including the wavelength λ_0 in which a reflectance R' of a
hypothetical layer is not higher than +2.0% from reflectance R' at the wavelength λ_0 of a
hypothetical layer having a thickness of $5\lambda_0/(4n_f)$ of a refractive index n_f ~~formed, disposed~~ on
the at least one of opposing end faces ~~satisfies a relationship, and satisfying~~

$$R' = ((n_c - n_f^2)/(n_c + n_f^2))^2,$$

~~wherein the where~~ n_c denotes an effective refractive index of the waveguide layer.

2. (Currently Amended) A semiconductor optical device comprising:
a waveguide layer including two cladding layers and an active layer sandwiched
between the two cladding layers; and
a reflecting multi-layer film ~~formed including a plurality of layers and disposed~~ on at
least one of a pair of opposing end faces of the waveguide layer, wherein
a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive ~~index indexes~~ n_i and ~~film~~
~~thickness thicknesses~~ d_i ~~for each of a layer denoted with i in~~ i layers of the reflecting multi-
layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a
~~relationship:~~

$$\Sigma n_i d_i > \lambda_0/4,$$

~~wherein a ratio~~ $\Delta\lambda/\lambda_0$ is not lower than 0.062, ~~the and~~
reflectance R in the bandwidth $\Delta\lambda$ ranges from -1.0% to +2.0% of ~~the~~
reflectance R at the wavelength λ_0 .

3. (Currently Amended) A semiconductor optical device comprising:
a waveguide layer including two cladding layers and an active layer sandwiched
between the two cladding layers; and
a reflecting multi-layer film ~~formed including a plurality of layers and disposed~~ on at
least one of a pair of opposing end faces of the waveguide layer, wherein
a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive ~~index indexes~~ n_i and ~~film thickness~~
~~thicknesses~~ d_i of ~~a layer each of denoted with i in layers~~ of the reflecting multi-layer film, and
a wavelength λ_0 of light guided through the waveguide layer satisfies ~~a relationship~~:
$$\Sigma n_i d_i > \lambda_0/4, \text{ and}$$
~~wherein a ratio $\Delta\lambda/\lambda_0$ is not lower than 0.066, the and~~
reflectance R in the bandwidth $\Delta\lambda$ ranges from -1.5% to +1.0% of the reflectance R
at the wavelength λ_0 .

4. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1,
wherein the reflecting multi-layer film includes a first ~~film~~ layer having a refractive index
larger than a square root of an effective refractive index n_c of the waveguide layer and a
second ~~film~~ layer having a refractive index smaller than the square root of the effective
refractive index n_c .

5. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 4,
wherein the first ~~reflecting film layer~~ and the second ~~reflecting film layer~~ are layered
alternately.

6. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1,
wherein a first-layer ~~film~~ of the reflecting multi-layer film, which is in contact with the
waveguide layer, has a refractive index smaller than a square root of an effective refractive
index n_c of the waveguide layer.

7. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1,
wherein the reflecting multi-layer film includes at least three layers made of ~~material~~
materials different from each other.

8. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1,
wherein the reflecting multi-layer film includes seven ~~films~~ layers.

9. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes six ~~films~~ layers.

10. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes nine ~~films~~ layers.

11. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer film of the reflecting multi-layer film, in contact with the waveguide layer, has ~~the highest a~~ heat conductivity in the films in ~~higher than other layers~~ of the reflecting multi-layer film.

12. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer ~~film~~ of the reflecting multi-layer film ~~is~~, in contact with the waveguide layer ~~made of,~~ is aluminum nitride.

13. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein ~~a minimal~~ minimum value of the reflectance of the reflecting multi-layer film is within range from 1% to 32%.

14. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein a first-layer ~~film~~, which is in contact with the waveguide layer, and a second-layer ~~film~~ of the reflecting multi-layer film have a refractive index smaller than a square root of an effective refractive index n_c of the waveguide layer.

15. (Currently Amended) ~~A~~ The semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes eight ~~films~~ layers.